IMP. INST. ENT.
LIBRARY
31 DEC1937
SERIAL
SEPARATE
Usa. 2

Bulletin 400 September, 1937

Some Common Household Insects and Their Control

NEELY TURNER AND B. H. WALDEN

Connecticut
Agricultural Experiment Station
New Haven

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

BOARD OF CONTROL

His Excellency, Governor Wilbur L. Cross, ex-officio, President
Elijah Rogers, Vice-President ..... Southington
Edward C. Schneider, Secretary ..... Middletown
William L. Slate, Treasurer ..... New Haven
Joseph W. Alsop ..... Avon
Charles G. Morris ..... Newtown
Albert B. Plant ..... Branford
Olcott F. King ..... South Windsor

STAFF

Administration.

William L. Slate, B.Sc., *Director.*
Miss L. M. Brautlecht, *Chief Clerk and Librarian.*
Miss Katherine M. Palmer, B.Litt., *Editor.*
G. E. Graham, *In Charge of Buildings and Grounds.*

Analytical Chemistry.

E. M. Bailey, Ph.D., *Chemist in Charge.*
C. E. Shepard, Owen L. Nolan, Harry J. Fisher, Ph.D., W. T. Mathis, David C. Walden, B.S., *Assistant Chemists.*
Miss Janetha Shepard, *General Assistant.*
Chas. W. Soderberg, *Laboratory Assistant.*
V. L. Churchill, *Sampling Agent.*
Mrs. A. B. Vosburgh, *Secretary.*

Biochemistry

H. B. Vickery, Ph.D., *Biochemist in charge.*
George W. Pucher, Ph.D., Rebecca B. Hubbell, Ph.D., *Assistant Biochemists.*
Lawrence Nolan, *General Assistant.*

Botany.

E. M. Stoddard, B.S., *Pomologist, (Acting Botanist in Charge).*
Miss Florence A. McCormick, Ph.D., *Pathologist.*
A. A. Dunlap, Ph.D., *Assistant Mycologist.*
A. D. McDonnell, *General Assistant.*

Entomology.

W. E. Britton, Ph.D., D.Sc., *Entomologist in Charge, State Entomologist.*
B. H. Walden, B.Agr., M. P. Zappe, B.S., Philip Garman, Ph.D., Roger B. Friend, Ph.D., Neely Turner, M.A., *Assistant Entomologists.*
John T. Ashworth, *Deputy in Charge of Gypsy Moth Control.*
R. C. Botsford, *Deputy in Charge of Mosquito Elimination.*
J. P. Johnson, B.S., *Deputy in Charge of Japanese Beetle Control.*
Miss Helen A. Hulse, Miss Betty Scoville, *Secretaries.*

Forestry.

Walter O. Filley, *Forester in Charge.*
H. W. Hicock, M.F., *Assistant Forester.*
J. E. Riley, Jr., M.F., *In Charge of Blister Rust Control.**
Miss Pauline A. Merchant, *Secretary.*

Plant Breeding.

Donald F. Jones, Sc.D., *Geneticist in Charge.*
W. Ralph Singleton, Sc.D., Lawrence Curtis, B.S., *Assistant Geneticists.*
Miss Elizabeth Williams, B.S., *Research Assistant.*
Mrs. M. C. Preston, *Secretary.*

Soils.

M. F. Morgan, Ph.D., *Agronomist in Charge.*
H. G. M. Jacobson, M.S., Herbert A. Lunt, Ph.D., *Assistant Agronomists.*
Dwight B. Downs, *General Assistant.*
Miss Geraldine Everett, *Secretary.*

Tobacco Substation at Windsor.

Paul J. Anderson, Ph.D., *Pathologist in Charge.*
T. R. Swanback, M.S., *Agronomist.*
O. E. Street, Ph.D., *Plant Physiologist.*
C. E. Swanson, *Laboratory Technician.*
Miss Dorothy Lenard, *Secretary.*

---

* In cooperation with the U. S. D. A.

Printing by The Peiper Press, Inc., Wallingford, Conn.

CONTENTS

Introduction 837

Cockroaches 837

Ants 839

Clothes moths 841

Carpet beetles 843

Silverfish 846

Bedbugs 847

Mosquitoes 848

House Flies 849

Fleas 850

Dermested beetles 851

Wasps 851

Hibernating Beetles 851

Wood-boring Beetles 852

Insect Pests of Stored Foods 852

Insecticides 852

- Fumigants 852
- Sprays 853
- Other Insecticides 854
- Storage of Insecticides 854

Literature 855

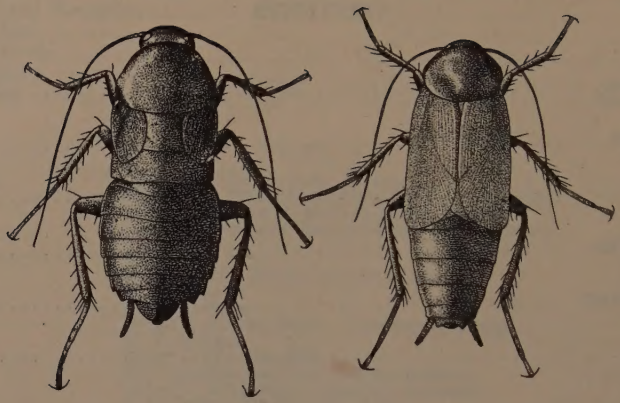

Figure 73. The Oriental Cockroach; female at left, male at right. About twice natural size.

Figure 74. The German Cockroach. About twice natural size.

Figure 75. The American Cockroach. About twice natural size.

Some Common Household Insects and Their Control

Neely Turner and B. H. Walden

Insects cause a large amount of damage to fabrics, foods, paper, books and other materials commonly found in homes. In addition many insects carry or transmit diseases that may affect the health of Man. Several types are very annoying, and although they cause no financial loss may frequently arouse more interest than the destructive species. Most of the damage and annoyance caused by household insects can be prevented by proper care and storage of articles and small expenditures for insecticides.

Pest control companies operate in all of the cities in the State and specialize in the control of household insects. Most of these companies are managed by experienced men who have developed materials and effective methods. In many cases of serious infestations their services are necessary in order to obtain adequate results. In some cities local ordinances require that all fumigations be done by licensed operators. On account of the dangers involved in fumigations by untrained men, it is suggested that all building fumigations be carried out by pest control operators, even if this is not legally required.

This bulletin has been prepared to give information about the more common household pests. It is based mostly on records of this department and in part on reports in the literature listed on page 855. The drawings for the illustrations were prepared by Mrs. Elizabeth Kaston.

COCKROACHES

Cockroaches are among the most common of household pests and are dreaded by all careful housekeepers. They occur in slaughterhouses, stores, bakeries, restaurants, warehouses, factories and other commercial establishments, especially where foodstuffs are handled and where there is heat, moisture and refuse in which they can live. Cockroaches may be brought into the home in bulky packages from the above sources. A few specimens escaping in the house will quickly conceal themselves in cracks and crevices and come out after dark to feed. Thus a colony may often become established before the presence of the pest is discovered. They feed upon almost anything that is soft enough for them to handle with their jaws, but prefer foods containing starch. When cockroaches are abundant, the food that they actually eat is only a small part of the damage. They ruin much more by soiling it in crawling over and dropping their excrement on it, which imparts a disagreeable "roachy" odor that is impossible to remove.

Cockroaches belong to the Order Orthoptera, which includes grasshoppers, katydids and crickets. They are oval in shape and have thin, flat bodies which are suited to the restricted places in which they live. The head is nearly concealed by the thorax and has a pair of long, bristle-like

antennae. Long slender legs allow them to move rapidly when disturbed. The males of our species have four well-developed wings, but the wings of the females in certain species may be more or less abbreviated. The color varies from light yellowish brown in some species to very dark brown in others.

The eggs are laid several at a time in a pouch-like capsule dropped by the female in some suitable place or often wherever she may be at the time. Upon hatching, the young nymphs have the same general shape as that of the adults. They molt or shed their skins from five to seven times, increasing in size each time and becoming full grown with wings at the last molt. None of the species mentioned here are native to this section of the country but were distributed long ago, principally by ships, to nearly all parts of the civilized world.

German roach, "Croton bug", "water bug", *Blattella germanica* Linn. (Figure 74.)

This cockroach is our smallest species and is the one that is most commonly found in dwellings. It is called "water bug" because it is often found around the water pipes, along which the cockroaches pass to various parts of the building or from one house to another in congested sections. The name "Croton bug" was applied to this cockroach because it appeared in many houses in New York City soon after the pipes had been connected with the Croton Water System.

The German cockroach is from one-half to five-eighths of an inch in length. It is of a light brown color with two dark brown, longitudinal stripes on the thorax, separated by a distance slightly greater than their width. This species increases in numbers more rapidly than do the other kinds that infest houses, and all stages, from eggs to adults, are found together in the moist warm places where they live. Although feeding upon a great variety of materials, including nearly all foodstuffs, they are especially fond of those containing starch. When abundant, they have been known to ruin books to get at the paste used in the bindings. They delight to get behind loose wall paper, where they feed upon the paste and at the same time find an ideal hiding place.

American cockroach, *Periplaneta americana* Linn. (Figure 75.)

The American cockroach is nearly one and one-half inches long and chestnut brown. The thorax of the female may be uniform dark brown while that of the male is lighter in color with a bi-lobed spot on the disk and the posterior margin dark brown. The wings are well developed in both sexes.

This cockroach is a native of tropical America and can live in the North only under artificial conditions. It is found in warm, moist places where there is an abundance of refuse and filth, and often occurs in numbers with the German cockroach in slaughterhouses and the poorer class of restaurants and bakeries. In the summer it has been found in city dumps where infested refuse has been allowed to accumulate, and often enters nearby houses. Many complaints have been received from persons living within a half mile of such dumps.

Oriental cockroach, *Blatta orientalis* Linn. (Figure 73.)

The Oriental cockroach is about one inch long. The males are dark brown in color and the females are often nearly black. The wings of the

male extend about two-thirds the length of the abdomen, while the females have no under wings and the wing-covers are less than one-fourth of an inch long. This insect is a native of the Orient and, although distributed throughout the United States, appears to be scarce in Connecticut.

Control

Cleanliness is essential in avoiding large infestations of roaches. Places in which food is kept should be absolutely clean of any refuse. Since roaches hide away and breed in cracks, all such places should be filled with crack filler. Cabinets and storage platforms should be built so that there are no hidden recesses in which roaches may hide. In restaurants and bakeries a concrete sanitary cove should be used instead of an ordinary wooden baseboard.

However, even under the most sanitary conditions roaches may be carried in on foodstuffs from an infested commercial establishment, or may migrate from an infestation nearby. If control measures are undertaken promptly, a severe infestation from such a source can be prevented.

In the ordinary dwelling pure ground pyrethrum flowers sprinkled over the shelves where roaches are seen will usually prove effective. The powder should be replaced every two or three days until no more roaches appear. Sodium fluoride is highly effective when used in the same manner, but it is a poisonous material. Its use should be confined to floors or basements rather than to shelves where bulk foods are stored. Phosphorous roach pastes, which are commonly sold by drugstores, give excellent control but should be used with caution since they are poisonous. The ordinary household sprays may be depended upon if they can be applied to the hiding places of the roaches.

In severe infestations, in thickly populated communities and in some commercial establishments, control is more difficult. Sodium fluoride or pyrethrum blown into infested partitions and behind shelves and cabinets will kill many roaches. A power duster should be used in making such applications and all food supplies removed to prevent contamination by insecticides. Repeated applications may be necessary to reduce the infestations to a low point. Sometimes fumigation is cheaper and more effective than the use of dusts. Under such conditions it is very difficult to keep cockroaches from any one building without concerted efforts. Unless a whole community acts at one time, reinfestation may occur.

ANTS

Several species of ants invade dwellings and eat food supplies, particularly sweets, bread and cake, and, occasionally, meat. The small red Pharaoh's ant (*Monomorium pharaonis* L.) and the larger black pavement ant (*Tetramorium caespitum* L.) nest in and under houses and are frequently troublesome during the winter months. The large black carpenter ant (*Camponotus herculeanus pennsylvanicus* DeG.) nests in wood and sometimes is destructive to porch and house timbers. The lawn ants (*Lasius niger americanum* Em. and *Lasius integer* Mayr.) nest out-of-doors and cause annoyance during the summer months.

Ants live socially in colonies and the workers enter houses to seek food. Although they actually eat a very small amount they get into large quantities of food and make it unfit for use. At certain times winged males and

females may swarm from colonies of ants. These are sometimes mistaken for termites, but ants are "wasp-waisted" and they fly more freely than termites.

Control

Cleanliness around the kitchen and pantry may prevent ant infestations. It is necessary to keep crumbs off the floor and to dispose of bacon and ham grease, since these things are attractive to ants.

Poisoned baits are a very effective control because the workers carry the poisoned food to the nests and feed it to the entire colony. To be effective, ant baits should not contain enough poison to kill the workers before they return to the nest. When baits are used in or around infested houses it is best to place them in metal containers so that children and pets cannot get at the poison. Such containers are made by punching a hole in the side, near the base, of any small tin box. A nail or the handle end of a file will make a hole large enough for the ants to enter. (See Figure 76).

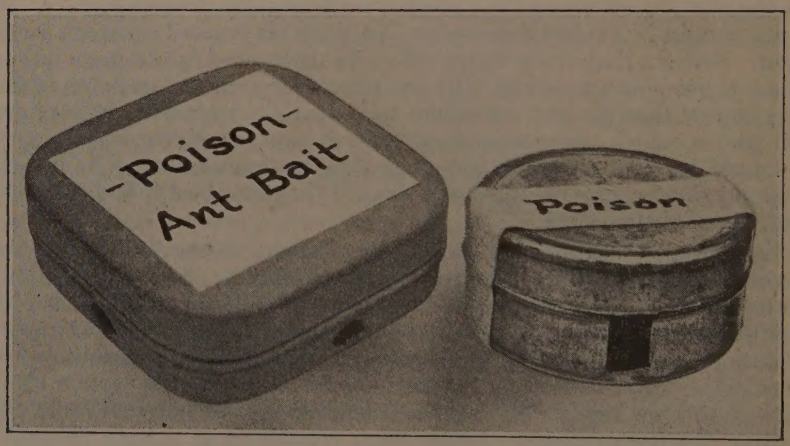

Figure 76. Metal containers for ant baits.

Ordinarily many ants are seen around the bait for a day or two and then disappear. Frequently a single effective baiting will rid the premises of ants for many months. Occasionally grease-feeding ants may not be attracted to ant baits. In such cases it is necessary to put a few drops of grease on the bait to attract them. Commercially manufactured thallium sulfate baits have been found highly effective in controlling ants. These are poisonous and must be used with care. Pyrethrum powder sprinkled on pantry shelves will kill many ants but is effective for only a few days. It kills the workers and therefore does not eliminate the colony unless it is used persistently.

A more complete account of ants is given in "Control of Ant Invasions," Connecticut Agricultural Experiment Station Bulletin of Immediate Information No. 67.

CLOTHES MOTHS

The larvae of the clothes moths cause a great deal of damage by feeding on woolens, furs and feathers. In Connecticut the webbing clothes moth (*Tineola bisselliella* Hum.) is much more abundant than the case-making clothes moth (*Tinea pellionella* L.), while the tapestry clothes moth (*Trichophaga tapetzella* L.) has not been reported here.

The adults (Figure 77) of the webbing clothes moth are about one-fourth of an inch long, buff-colored and fragile. They prefer darkness but occasionally fly about at night, avoiding brilliant lights. Living moths are frequently seen in infested clothing. They live only two or three weeks and do not feed on the material. Each female may deposit about 100 eggs on woolen clothing, the nap of furniture, or furs. The eggs are white, very fragile, and are not firmly attached.

Figure 77. The webbing clothes moth and moth eggs. About six times natural size.

Figure 78. Larva of the webbing clothes moth and silken tube. About six times natural size.

The larvae hatch in from four days to four weeks, depending on the temperature. They immediately start feeding and spin a thin tube of silk in which they stay. Fully grown larvae (Figure 78) are white with dark heads and are about three-eighths of an inch long. They spin a cocoon and pupate, either on or nearby the infested material. The period of development varies greatly, depending on the temperature and food supply. In centrally heated buildings the moths may breed throughout the year, completing at least two generations.

Clothes moths damage wool, hair, fur, feathers or any article manufactured from these materials. Damage to clothing is readily noticed, but the injury to piano felts and to upholstered furniture is not so easily seen. Frequently piano felts are so badly damaged that re-felting is necessary. In furniture upholstered in woolen materials the larvae usually live within the furniture and cut the woolen strands of nap. The

damage is noted when bare spots of warp appear on the fabric. Rugs in use are seldom damaged but clothes moths will attack rugs in storage or in uninhabited houses.

Clothes moths cannot live on cotton, linen, silk or jute fabrics, although occasionally larvae will cut through such materials to reach wool.

The case-making clothes moth has a similar life history and habits, except that the larva lives in a case made of spun silk and pieces of fabric.

Sources of Infestation

Clothes moths seldom breed in large numbers on clothing that is regularly worn. However, large infestations are built up in stored materials. When such infestations exist it is difficult to prevent occasional damage to clothing in use. In actual experience these sources of infestation have been found in bundles, boxes and trunks of clothing, old rugs stored in attics, discarded clothing and rag-bags hanging in basements, pianos, upholstered furniture, and accumulated lint in cracks. It is absolutely necessary to remove these sources of infestation in order to control clothes moths.

The larvae prefer soiled or dusty clothing as food. Therefore it is advisable to keep all susceptible materials dry-cleaned or washed in order to prevent damage, and especially to clean them before storing them for any length of time. It is possible to keep clean woolens in an ordinary closet with little danger if the clothing is sunned and brushed at frequent intervals. The brushing crushes or removes the eggs and many of the larvae, and heat and light either kill or drive off the larvae. It is necessary to brush thoroughly all folds or pockets in which the larvae might hide.

The chief value of a well-made cedar chest is that it provides a tight receptacle in which to store uninfested clothing. The volatile oil of cedar will kill newly hatched larvae but does not always kill moths nor prevent damage by any older larvae introduced with the clothing. Cedar chests should be kept closed to prevent loss of the volatile oil.

Cedar-lined closets, as ordinarily constructed and used, will not prevent damage by clothes moths.

Paper garment bags or cardboard closets with tight-fitting double doors will protect uninfested clothing as long as they are sealed tight. A pound of paradichlorobenzene in a cloth bag hanging at the top of such containers should protect the clothing for several weeks.

Clothing stored in trunks and boxes may be fumigated by placing about one-half pound of paradichlorobenzene in the top of each container or scattering it over the clothing. The fumigation will be more effective if the temperature is above 70° F. A new supply of paradichlorobenzene should be added every six months.

After such treatment any clothing worn next to the body should be aired before use since paradichlorobenzene is irritating to tender portions of the skin.

Pianos

According to Dr. E. A. Back, piano felts may be protected by hanging four ounces of paradichlorobenzene in a muslin bag inside the piano case and closing all openings. This is especially necessary in warm weather and the case should be kept closed as much as possible. Sprays should not be applied unless it is certain that they will not injure the piano parts.

Upholstered Furniture

Furniture upholstered with wool or mohair fabrics can be protected by fumigation followed by a moth-proofing treatment. It is best to have this done by a warehouse or other concern having fumigation vaults.

It is also possible to kill the moths by use of a contact spray applied with a power sprayer.

In recent years many furniture factories are using only moth-proofed woolens for upholstery.

Rugs and Carpets

Clothes moths seldom damage rugs and carpets in constant use, especially if the carpeting is not fastened to the floor. If rugs are stored, or if a house is closed for several months, each room-sized rug should be sprinkled with about one pound of paradichlorobenzene, rolled up, and wrapped tightly with strong paper and sealed.

Furs

Furs may be cleaned and stored in the same manner as woolen clothing. There are commercial establishments which specialize in fur storage, either in cold storage or in moth-proof vaults.

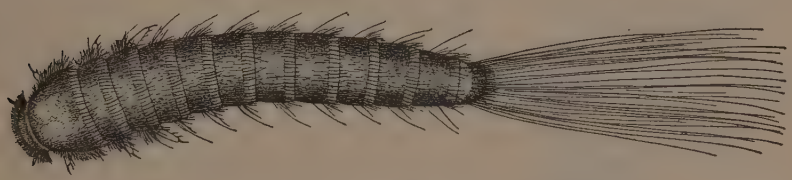

Figure 79. Larva of the black carpet beetle, about twelve times natural size.

Moth-proofing

During the past few years several moth-proofing compounds have been developed. Such compounds are very useful to prevent damage by clothes moths, but do not make fabrics completely and permanently moth-proof. Washing and dry-cleaning either remove the effective material or lessen its protective properties. Moth-proofing compounds can be most effectively applied during the manufacture of fabrics. Application in the home is not likely to be satisfactory unless a power sprayer is used.

CARPET BEETLES

During the past 10 years carpet beetles have apparently increased in abundance and have caused more damage than formerly in Connecticut. The black carpet beetle (*Attagenus piceus* Oliv.) is by far the most common in dwellings. The larva (Figure 79) is light brown, long and slender, slightly hairy with a conspicuous terminal brush of hairs, and is almost one-half inch long when fully grown. The adult (Figure 80) is a small, brownish black beetle about one-eighth of an inch long.

Figure 80. The black carpet beetle, about twelve times natural size.

The buffalo carpet beetle (*Anthrenus scrophulariae* L.) is less common but is widely distributed. The larva (Figure 81) is oval in shape, much darker in color and more hairy than the larva of the black carpet beetle. The terminal brush of hairs is short and inconspicuous. The adult (Figure 82) is a small beetle, about one-eighth of an inch long. The color is black marked with reddish, white and yellow spots.

The varied carpet beetle, or museum beetle, (*Anthrenus verbasci* L.) is apparently not very common in dwellings but is a pest of insect and animal

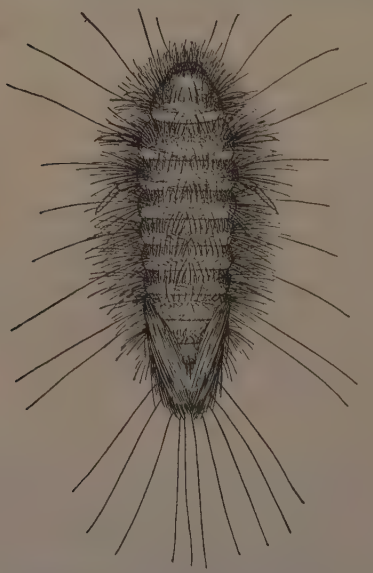

Figure 81. Larva of the buffalo carpet beetle, about twelve times natural size.

Figure 82. The buffalo carpet beetle, about twelve times natural size.

specimens in museums. The larva looks much like the larva of the buffalo carpet beetle and the adult is similar in shape but is much smaller and marked with brown and white.

The furniture carpet beetle (*Anthrenus vorax* Csy.) has not been reported from Connecticut. Larvae of *Trogoderma* sp. have been taken in houses but are apparently not common.

For many years carpet beetles damaged room-sized carpets which were tacked to the floor. They worked along cracks in the flooring, cutting the wool fibers from the warp and leaving a bare streak in the carpet. Since the advent of rugs and hardwood floors, these pests have caused more damage to woolen clothing, fur and feathers than to rugs. The larvae may also eat cereals, dried milk and other food products.

Many housekeepers have associated larvae of the carpet beetles with adult clothes moths. There is no relation whatever between these two pests except the fact that both damage the same fabrics.

The adult beetles begin to appear in March in heated houses but occur in largest numbers in May and June. They deposit their eggs on clothing or on accumulated lint in cracks. They then collect at windows and attempt to leave the house. Large numbers gather on flowers of shrubs, particularly spiraea. Hundreds of adult beetles have been found on the window sills of infested houses left vacant during the spring months.

The larvae feed on fabrics or on woolen lint in cracks and usually hide in a crack or crevice to molt. Afterward they again seek food. There is no webbing around their feeding places and larvae are seldom found on the garments they injure. A sweater placed in a closet in the evening has been found damaged the next morning but no larvae were found on the garment. They seem to be attracted to soiled spots on clothing, particularly milk spots.

Larvae molt several times during development, each time leaving a cast skin. Many cast skins can be found in the cracks of infested closets. There is usually one generation a year.

Control

In general the control measures given for clothes moths apply to carpet beetles. However, their habit of molting in cracks makes control more difficult. Fumigation is not effective unless a large amount of gas is used because the gases do not penetrate the cracks very well.

The most important control measure is the treatment of cracks in the floor and under baseboards, especially in clothes closets. Water-white kerosene applied to these cracks with a spring-bottom oil can will kill many larvae. Thorough application of sprays under and behind baseboards is also necessary. The most effective way is to eliminate the cracks by using a crack filler or by covering closet floors tightly with linoleum. A quarter-round may be used to close the crack between the baseboard and the floor, and plaster or crack filler used between the baseboard and the wall.

In finished rooms treatment of cracks with kerosene and use of a quarter-round on the baseboard are usually adequate measures. Sometimes carpet beetles breed in lint accumulated behind ornamental molding over window and door frames and on top of built-in cabinets which do not extend to the ceiling. These places should be cleaned frequently.

Storage of clothing and furs to prevent carpet beetle damage should be done in the same way as described to prevent damage by clothes moths.

SILVERFISH

Silverfish or bristle-tails (*Lepisma saccharina* L., *Clenolepisma quadriseriata* Pack. and *Thermobia domestica* Pack.) are small wingless insects, silver-gray in color and about one-third of an inch long, with three long slender projections at the posterior end of the body (Figure 83). They are wary and hide quickly if they are exposed to the light. They prefer damp locations for breeding and are especially abundant in hot, damp, basement rooms and occasionally in attics. They are frequently troublesome in new masonry buildings that have not dried out thoroughly.

Silverfish feed on starch and are particularly injurious to book bindings and wallpaper. Back states that they may eat starched clothing, carpets, plush coverings of furniture and window shades. In Connecticut their damage has been confined chiefly to wallpaper and to books, clothing and window shades stored in attics. On one occasion a room was papered during the absence of the owner and the house closed for two weeks afterwards. Silverfish ruined the paper, feeding mostly near door and window frames and baseboards.

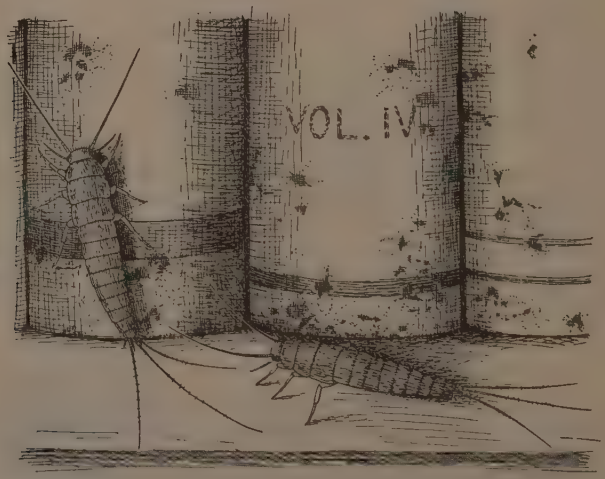

Figure 83. Silverfish and their damage to book bindings. About twice natural size.

Control

Dr. E. A. Back, of the Federal Bureau of Entomology and Plant Quarantine, has just published the following statement on control:

"An excellent bait can be made of the following ingredients in the proportions indicated:

Oatmeal	1¾ cups
White arsenic	¼ teaspoonful
Granulated sugar	½ "
Salt (table)	¼ "
Water to make moist	

Mix together dry the oatmeal, white arsenic, sugar, and salt. Moisten

the mass and mix thoroughly to bind the substances together. Then thoroughly dry the bait to prevent mold, and grind it into small bits so that it can be scattered easily.

"Sodium fluoride powder can be substituted for the white arsenic in the above formula. But if the substitution is made, use no moisture.

"Place a teaspoonful of the bait in each of several or many shallow cardboard boxes, such as necktie boxes, and distribute the boxes near or in the haunts of the silverfish, and cover each box loosely with a crumpled sheet of paper to form a hiding place for the insects. The bait can be placed without boxes behind baseboards, behind books on shelving, or in other out-of-the-way places, but if exposed in boxes it can be kept cleaner and can be disposed of more easily. It is wise to place several doses of bait in each room where control is needed, or one in each trunk, or in each box of books stored in attics. The formula given will make about 90 teaspoonfuls of bait. White arsenic, like sodium fluoride, is poisonous to man and animals; hence the bait should be placed where children or pets can not eat it."

"Pyrethrum powder dusted or blown into places frequented by silverfish is also useful. For quickly killing the hordes of silverfish found overrunning basements and furnace and storage rooms, spray with a saturated solution of paradichlorobenzene in carbon tetrachloride. As the liquid evaporates the paradichlorobenzene recrystallizes as a fine snow over the object sprayed, but will, in turn, evaporate, causing no injury. The best results are secured by keeping the rooms closed for 24 hours after spraying. Where infestations are heavy much good can be accomplished by applying the common kerosene sprays prevalent on the market. These are best applied by professional exterminators with powerful spray machines but can be applied with ordinary hand sprayers. In most homes sprays are not usually sufficient, as silverfish secrete themselves in all sorts of containers, the contents of which it is not easy to treat properly. Baits are better because the silverfish find them while out foraging during the night.

"Attempts to kill silverfish by poisoning the paste with which wall paper is applied have not proved practical."[1]

BEDBUGS

The bedbug (*Cimex lectularis* L., Figure 84) is a wingless sucking insect that lives on human blood. Its body is wide and flat, enabling it to hide in cracks in furniture, under loose wallpaper and in cracks in floors and walls. Eggs are deposited in these places in infested rooms. The young bugs are not unlike mature ones and under favorable conditions may complete their development within six weeks. The odor of bedbugs is very characteristic and easily identified. They are nocturnal in habit and are seldom seen in the daytime.

Bedbugs are carried from place to place in the baggage or on the clothing of transients and occasionally in packages. They may be brought into uninfested houses by moving in infested furniture. They may crawl from house to house in thickly settled neighborhoods. They are able to live without food for several months or possibly feed on the blood of mice and thus maintain an infestation in vacant houses.

[1] Quoted from United States Department of Agriculture Mimeo. E-415 published September, 1937.

Control

Fumigation with hydrocyanic acid gas has been the most effective method of eliminating bedbugs. This should always be done by an experienced operator. Recently ethylene oxide-carbon dioxide mixture has been used successfully for this purpose. It is somewhat more expensive than hydrocyanic acid gas but is much less toxic to humans.

A thorough spraying of the cracks in the bed, bedroom furniture, floors and walls with pure kerosene, or with a household fly spray, will kill many bedbugs, and if repeated several times at intervals of three or four days should eliminate ordinary infestations. Gasoline should not be used

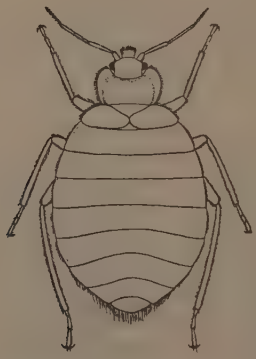

Figure 84. The bedbug, about eight times natural size.

on account of the fire hazard. Household sprays containing rotenone have been very effective for bedbug control. It should be remembered that bedbugs sometimes infest living rooms and that in such cases control measures are necessary in these rooms. In heavily infested houses with loose wallpaper and cracked plaster walls this method of control may not be successful.

MOSQUITOES

Mosquitoes are not only annoying, but the species belonging to the genus *Anopheles* may transmit malarial fever. All mosquitoes breed only in water, the eggs being deposited either on the surface, on mud, or attached to grass that may be flooded later. The larvae and pupae spend their entire lives in the water. Thirty-eight species of mosquitoes have been found in Connecticut and several of these commonly invade houses.

The house or rain-barrel mosquito (*Culex pipiens* L.) breeds in polluted streams, rain barrels, tin cans, or any place that may hold water for a week in the summer. It does not migrate far from the breeding place and is one of the most common forms found in houses.

The malarial mosquitoes (*Anopheles punctipennis* Say and *A. quadrimaculatus* Say) breed in various places and especially in the grassy margins of ponds and slow-moving streams. Both house and malarial mosquitoes may hibernate during the winter months, frequently in basements or attics

of houses. Hundreds of adults have been seen in a cellar hatchway in December. They may invade the house itself but seldom bite during the winter months.

Aedes vexans Meig. breeds in rain-filled pools in meadows and in filthy puddles. It sometimes invades houses and may migrate three or four miles from the breeding place.

Taeniorhynchus perturbans Walk. breeds in marshes containing vegetation. It is one of the most vicious biting mosquitoes and readily invades houses.

Control

Prevention of breeding is, of course, the most satisfactory method of control. For the house mosquito, this involves clearing streams of pollution and avoiding accumulations of water in barrels, tin cans, and similar places. For malarial mosquitoes, it is necessary to trim banks of ponds and streams perpendicularly to prevent grass from growing along the edges. This allows small fish to feed on the larvae. For the other species, either drainage or filling is necessary. Prevention of breeding requires a concerted community effort to be effective.

Thorough screening of houses keeps mosquitoes out. However, many may be carried in on the clothing, particularly at dusk. Under certain conditions adult mosquitoes may be small enough to crawl through the ordinary screen. Entry may be prevented in such cases by placing a small amount of oil of citronella on a cloth and rubbing it over the screen, or by spraying the screen with a household fly spray which contains a repellent. Mosquitoes frequently get into apparently well-screened houses through open cellar hatchways.

A thorough spraying of a room with one of the household fly sprays is very effective in killing mosquitoes.

Information on ditching and draining for prevention of breeding is given in the State Department of Health Pamphlet, "The Mosquito Problem of Connecticut and How to Solve It", by W. E. Britton.

HOUSE FLIES

The common house fly (*Musca domestica* L.) is not only an annoying insect but may also carry disease germs. House flies breed in manure, garbage and compost heaps. In warm weather the entire life cycle requires about 10 days and there are several generations each summer. They pass the winter in the adult stage in buildings and in the pupal stage in breeding places.

The lesser house fly (*Fannia canicularis* L.), the stable-fly (*Stomoxys calcitrans* L.) and the blue-bottle fly (*Calliphora vomitoria* L.) are occasionally seen in houses. The cluster fly (*Pollenia rudis* Fab.), which collects in clusters in corners of a room and under rafters in attics or basements, is sometimes abundant in rural homes.

Control

Careful screening will do much to eliminate flies from houses. However, in cool or rainy weather flies gather around the doors and a few get into the house every time the screened door is opened. Prevention of breeding is one of the best methods of control but must be carried out by an entire

community to be effective. Such efforts are usually made through the local health officer. The ordinary household sprays are very useful in killing flies in houses. It is best to close the windows and doors of the room to be treated during spraying and for a few minutes afterwards.

A complete account of the house fly is given in the pamphlet, "The House Fly", by Dr. W. E. Britton, published by the State Department of Health, Hartford, Conn.

FLEAS

The common flea which is found in houses in Connecticut is the dog flea (*Ctenocephalides canis* Curtis). This species breeds on both cats and dogs and does not occur in houses in large numbers unless a cat or dog is, or has been, present.

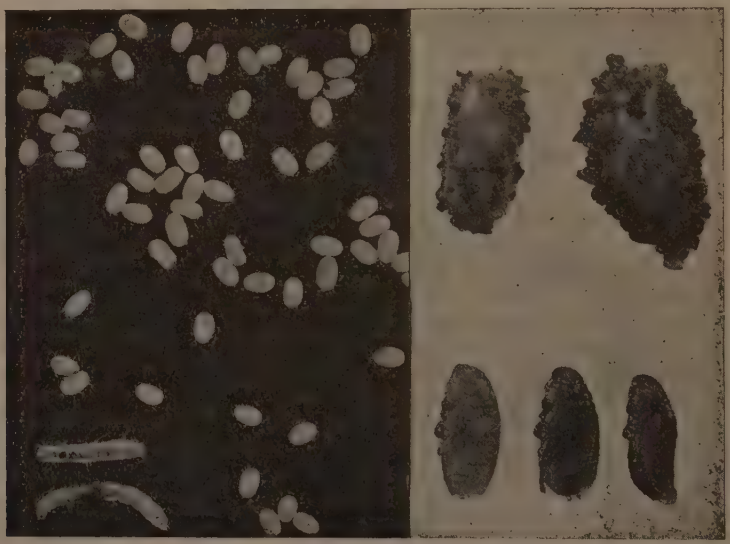

Figure 85. Dog flea. Eggs at left, larvae lower left, cocoons upper right, pupae lower right. Enlarged eight times.

The adult fleas deposit eggs (Figure 85) among the hairs of the host, but the eggs are not attached and usually are shaken off. Large numbers accumulate in the animal's bedding. The white, worm-like larvae feed on organic material in lint and dust and on bits of skin and dried blood. They pupate in a cocoon and emerge in about a week. Normally fleas do not occur in large numbers if the animal's bedding is changed frequently. Very large infestations develop sometimes when a house is closed for several days. The larvae continue to hatch from the eggs, feed to maturity and emerge. When the house is reopened there may be hundreds of adult fleas which cause a great deal of annoyance. Such infestations might be lessened in severity, or avoided entirely, by thoroughly cleaning or destroying the animal's bedding and spraying the basement and those upstairs rooms frequented by the pet before closing the house.

In one case a heavy infestation of fleas developed in a house basement. A kitten had been sleeping there during the winter but was removed in the

spring. Several days later the basement was found heavily infested by fleas. Examination of the bedding disclosed the presence of many eggs, larvae and pupae, as well as hundreds of adults. Adults were carried to all parts of the house on clothing.

Control

The first necessity is to rid the animal of fleas and to keep its bedding free of fleas. Flea powders containing derris or pyrethrum may be rubbed into the animal's fur and will kill many fleas. Dogs may be washed in a 3 percent solution of creolin and cats in a 2 percent solution. The bedding should be changed frequently and the old bedding washed or destroyed.

Flake or granular naphthalene scattered over the floor at the rate of five pounds for each room has been effective. The room should be closed for 24 hours and then the remaining naphthalene may be swept up and transferred to other rooms.

A derris-kerosene household spray proved highly effective in one case. One pint of the material was applied to a basement and two upstairs rooms by means of a small hand sprayer. A second application was made 10 days later and apparently eliminated the fleas.

A more complete account of fleas is given in Connecticut Agricultural Experiment Station Circular 97, "Fleas and their Control", by B. H. Walden.

DERMESTID BEETLE IN INCINERATORS

A large dermestid beetle (*Dermestes cadaverinus* Fab.) has been found in houses several times since 1930. This beetle is brownish-black in color, about one-half of an inch long and rounded oblong in shape. In every case the infestation developed in refuse in built-in incinerators. Garbage lodged on the uneven surfaces of the incinerator flues furnished food for the larvae. Moreover, the fires in these incinerators were not sufficiently hot to consume all of the garbage. As a rule waste paper was the only source of heat. It is necessary to use gas or oil to burn all of the refuse, or to clean the grates at least once a week to prevent breeding. The use of smooth fire tiles, instead of rough masonry lining, will prevent garbage from lodging in the flues.

WASPS

Wasps (*Polistes pallipes* LeP.) frequently invade houses, usually entering attics in cold weather in the fall. In early spring they crawl down into the upper rooms of the house. They may be kept out by screening the attic windows and closing any cracks under the eaves.

Household fly sprays will kill wasps very quickly.

HIBERNATING BEETLES

Occasionally large numbers of ladybeetles (especially *Adalia bipunctata* L.) and elm leaf beetles (*Galerucella xanthomelaena* Schr.) enter houses to hibernate. They crawl in through cracks in clapboards and under the eaves, and become active in early spring. They do not damage anything and are simply an annoyance. They may be killed by use of one of the household sprays. Ladybeetles are beneficial and should be allowed to escape to the open air.

WOOD-BORING BEETLES FROM FIREPLACE WOOD

Several species of long-horned wood-boring beetles may be brought into houses in fireplace wood. The larvae continue to develop and the beetles emerge in late winter or early spring. These beetles cannot infest the framework of the house or damage anything stored in houses. They are simply a nuisance and unless they emerge in unusually large numbers no control measures are necessary. A household spray is effective in killing them.

INSECT PESTS OF STORED FOOD

Many insect pests damage stored food, infesting it either during growth or as it is packed for distribution. Most of these pests are more commonly found in food processing plants than in homes, and control measures are carried out before the food products are sold. The insects listed here are the more common pests of this type.

The larder beetle (*Dermestes lardarius* L.) is a pest of meat and cheese. The Indian meal moth (*Plodia interpunctella* Hbn.) infests nutmeats, dried fruit and cereals. The saw-toothed grain beetle (*Silvanus surinamensis* L.) feeds on flour, cereals, dried fruits, nutmeats, sugar and starch. The drugstore beetle (*Sitodrepa panicea* L.) eats on a variety of materials including spices, chocolate, flour and cereals. Under present conditions these insects are seldom serious in the ordinary household. They are generally brought in in bulk or packaged foods, but seldom breed in large numbers unless the infested material is kept for several months.

Housewives usually destroy any small amounts of foodstuffs found infested. However, lightly infested cereals can be sifted to remove the insects and sterilized in a slow oven for two or three hours to kill any eggs present. Heat is not a satisfactory treatment for nutmeats, dried fruits and chocolate.

INSECTICIDES USED TO CONTROL HOUSEHOLD INSECTS

Fumigants

The use of fumigants to control household insects has been very successful, particularly in ridding an entire building of many of the insect pests that are present. The building must be vacated for at least 24 hours in most cases in order to complete the fumigation and remove the fumigant by ventilation. On account of the danger to humans in the use of highly poisonous chemicals and the technical knowledge and experience required for successful fumigation, it is best for the home owner to have such work done by commercial operators rather than do it himself. The popular materials, as used for this purpose, are without exception non-inflammable and non-injurious to metals, paint, varnish or fabrics.

Hydrocyanic acid gas is the most widely used fumigant. It is highly effective but is as poisonous to man as to insects. Ethylene dichloride-carbon tetrachloride, ethylene oxide-carbon dioxide and carbon dioxide-methyl bromide mixtures are less poisonous to man and have replaced hydrocyanic acid gas to some extent. Detailed directions for the use of these fumigants may be obtained from the manufacturers.

The fumigants suitable for use by the home owner in fumigating trunks, chests and closets are discussed in the following paragraphs.

Carbon disulfide (carbon bisulfide) is a colorless liquid which evaporates at ordinary temperatures into a highly inflammable, foul-smelling poisonous gas. The gas is explosive when mixed with air and for this reason carbon disulfide must be used with caution. It is suggested that some less dangerous material be used if possible.

Carbon tetrachloride is a volatile liquid frequently used instead of carbon disulfide. It is not inflammable but is poisonous. It may be used at the rate of one pound for each 50 cubic feet of space in a trunk, chest or tight closet. Since the gas is heavier than air, the shallow pan holding the required amount of liquid should be placed in the upper part of the space to be fumigated. For best results, the temperature should be maintained at, or above, 70° F. for at least 24 hours.

Paradichlorobenzene is a white crystalline material which vaporizes into a gas at ordinary temperatures. The gas is non-inflammable and comparatively non-toxic to humans. Its odor is pronounced and it is irritating if breathed in large quantities. However, clothes fumigated with paradichlorobenzene lose the odor very quickly on airing. As is the case with all fumigants, the gas must be confined to be effective and the temperature should be kept above 70° F. A small bag of crystals hanging in an ordinary closet which is in constant use will not be effective.

This is undoubtedly the most useful fumigant for household use. It is also sold under the trade names of "Dichlorocide", "Moth Crystals", "P.D.B.", "Purocide", "Extermo-cide", and "Crystal Gas".

Naphthalene is a white crystalline material which has been used as a fumigant for years. It does not evaporate as quickly as paradichlorobenzene and is therefore somewhat less effective. Moreover, its odor is more persistent in fumigated clothing. Although it has been widely used as a repellent, its chief value is as a fumigant.

Flake or granular naphthalene has been used successfully as a fumigant to kill fleas.

Sprays

There are now on the market a great many brands of household sprays. Most of those intended for general use consist of: (1) a kerosene extract of pyrethrum; (2) a mixture of kerosene and rotenone or derris; or (3) kerosene with both pyrethrum and rotenone or derris. The kerosene is usually odorless and colorless and the flash point is high enough to avoid inflammability under normal conditions. In general it is believed that the pyrethrum sprays are more effective in killing house flies and mosquitoes, and the rotenone sprays superior in controlling bedbugs and fleas.

A kerosene extract of pyrethrum can be made by mixing 12 ounces of pure ground pyrethrum flowers in one gallon of water-white kerosene. The mixture should be stirred occasionally for two or three hours, and, after allowing the pyrethrum to settle, the clear liquid may be poured off ready for use.

All household sprays act by contact with the insect. The materials are atomized or sprayed into the air in small particles that must touch the insect in order to kill it. Such sprays are highly effective in killing flies and mosquitoes, since the rooms can be closed and the air filled with mist. They are less successful in killing insects which hide in cracks and crevices.

In recent years several manufacturers have designed sprayers which use steam to atomize the sprays. The boiler is filled with water and heated by an electric hot plate, and escaping steam atomizes the spray material. Such steam atomizers are convenient but are apparently no more effective in killing insects than ordinary spray atomizers, provided the same amount of the same spray is used in both cases.

Other Insecticides

Ant baits usually contain some form of arsenic or thallium as the poisonous ingredient. Various forms of sugar are used to attract the ants. Although the baits are highly poisonous to humans, it is possible to use them carefully with little danger. On account of the danger in handling some of the poisonous ingredients, it is best to purchase prepared baits rather than attempt preparation at home. Recent observations have shown that the thallium sulfate baits prepared in paste form have been highly effective.

Sodium fluoride has been used in controlling ants and roaches. It is a finely ground powder which is dusted around the places frequented by these insects and is effective for several days after application. Sodium fluoride is poisonous to man and should not be used on pantry shelves or other places where it might contaminate foods.

Pyrethrum powder is non-poisonous to man and may be used freely around food supplies. It is effective for two or three days and kills entirely by contact. It is particularly suitable for control of ants and roaches. Pyrethrum powder is also known as "insect powder" and "buhach".

STORAGE OF POISONOUS INSECTICIDES

Poisonous insecticides should never be kept in cabinets containing food or medicines. They should be stored in a locked cabinet in a garage or basement. Moreover, poisonous powders should be kept in plainly marked containers and not placed in unmarked paper bags, jars or boxes.

LITERATURE

———. Carpet Beetles. U. S. Dept. Agr. Mimeo. E-395. 1936.

———. Clothes Moths. U. S. Dept. Agr. Mimeo. E-389. 1936.

———. Cockroaches. U. S. Dept. Agr. Mimeo. E-390. 1936.

Back, E. A. Carpet Beetles and Their Control. U. S. Dept. Agr. Farmers' Bul. 1346. 1923.

———. Clothes Moths and Their Control. U. S. Dept. Agr. Farmers' Bul. 1353. 1923.

———. The Silverfish as a Pest of the Household. U. S. Dept. Agr. Farmers' Bul. 1665. 1931.

Back, E. A. & Cotton, R. T. The Control of Moths in Upholstered Furniture. U. S. Dept. Agr. Farmers' Bul. 1655. 1931.

Britton, W. E. The Housefly as a Carrier of Disease Germs and How Controlled. Pamphlet Conn. State Dept. Health. 1932.

———. The Mosquito Problem of Connecticut and How to Solve It. Bulletin Conn. State Dept. Health. 1930.

———. Control of Ant Invasions. Conn. Agr. Expt. Sta. Bul. Immediate Information 67. 1929.

Herrick, G. W. & Griswold, Grace H. Common Insects of the Household. N. Y. (Cornell) State College of Agr. Ext. Bul. 202. 1931.

Walden, B. H. Fleas and Their Control. Conn. Agr. Expt. Sta. Circ. 97. 1934.